BY EMAIL

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ATTN: [Hannah Toberman & Elizabeth Voice]

[08/11/2021] Our Ref: SHLNG/TS/ENV/C/604

Dear Sir/Madam

RE: Request Notification for a temporary change to the permitted installation

Following the recent teleconference on the 05/10/2021 in relation to utilising Boil off Gas (BOG) as Fuel Gas during Minimum Send Out Operations, please accept this letter as South Hook LNG Terminal (SHLNG) notification request for a temporary change to its current permitted installation.

1) Background

SHLNG imports Liquefied Natural Gas and returns it safely to a vapour state prior to export to the UK's national gas grid. Our Terminal, purpose built for this operation, is capable of providing up to one fifth of the entire UK's gas demand and is proud to have safely achieved this for much of its operating life. At times however, the Terminal may also be commercially required to operate at minimum send out (MSO) of gas to the UK grid. As Liquefied Natural Gas (LNG) is a global commodity-based market, these global factors influence the UK's gas market and the operations at SHLNG.

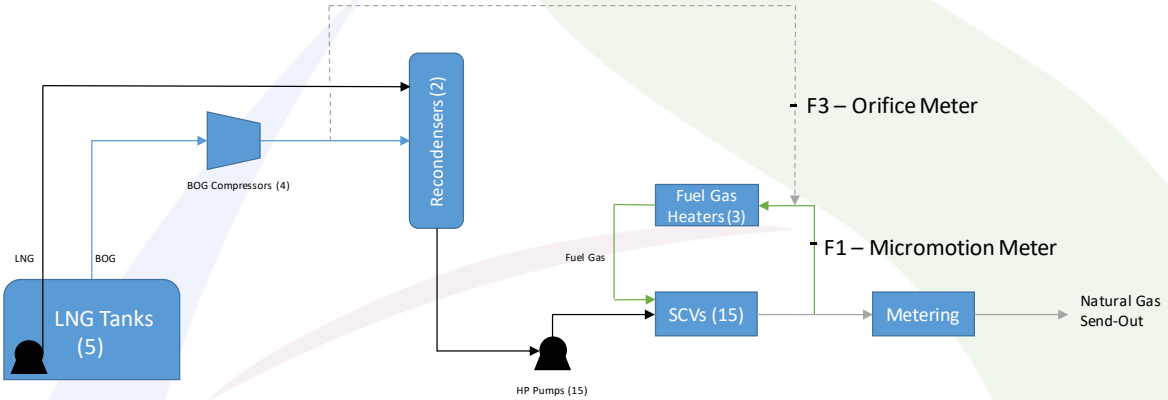
SHLNG comprises several combustion activities in LNG vaporisation. The major emission sources on site are the submerged combustion vaporisers which predominantly combust natural fuel gas (F1), and occasionally boil-off gas (F3).

In normal operations, the fuel gas taken from the send-out gas line is combusted in the fired heaters, its flow rate is continuously measured by the Coriolis flow meter (49-FT-93001) and its composition is determined by the online gas chromatograph. Boil-off gas generated in the LNG storage tanks is continuously compressed, routed to recondensers and incorporated in the send-out gas to the UK grid.

During the periods of minimum send-out, which have been extended recently due to commercial needs, the ratio of boil-off to send-out gas increases and leads to unavailability of recondenser capacity and the pressure rise in the tank headspace. Exceedance of the limit set for the absolute pressure in the tank headspace may lead to upsets in the Terminal

operation, trips, and relief of boil-off gas to the atmospheric flare. In this case the Terminal operation becomes sensitive to the variation of atmospheric pressure which cannot be controlled.

To improve the Terminal resilience to upsets, trips, and flaring events during the periods of minimum send-out, it is proposed utilising boil-off gas as a source of fuel. The boil-off gas flow rate can be continuously measured by the orifice plate flow meter (48-FT-93103), and its composition is determined in the accredited laboratory on monthly basis using gas chromatography (illustrated in the figure below). This alternative route for boil-off gas improves reliability and safety of the Terminal operation during the periods of minimum send-out by reducing impact of atmospheric pressure and decreasing probability flaring events; facilitates energy savings and improves overall efficiency. Recent successfully completed trials, have confirmed feasibility of the proposed alternative route for boil-off gas.



SHLNG Terminal is a category B installation and operates in accordance with the greenhouse gas emissions permit UK-W-IN-11929. F1 fuel gas source stream is defined in the permit as the only major source, and the highest tier 4 applied to activity data requiring uncertainty of 1.5 % to be met. Uncertainty of the Coriolis flow meter (49-FT-93001) is calculated in the report [12] and confirmed to be within the tier 4 uncertainty limits.

F3 boil-off gas source stream is defined as de-minimis if its annual emissions do not exceed 2 % of the annual emissions of the installation. There is no tier applied to the activity data of the de-minimis sources and uncertainty of the orifice plate meter (48-FT-93103) has never been assessed. However, the proposed alternative route for the boil-off gas handling may change the category of F3 source stream from de-minimis to minor/major. This change between categories will require the highest tier 4 with uncertainty of 1.5 % to be applied to activity data determined by the orifice plate meter (48-FT-93103).

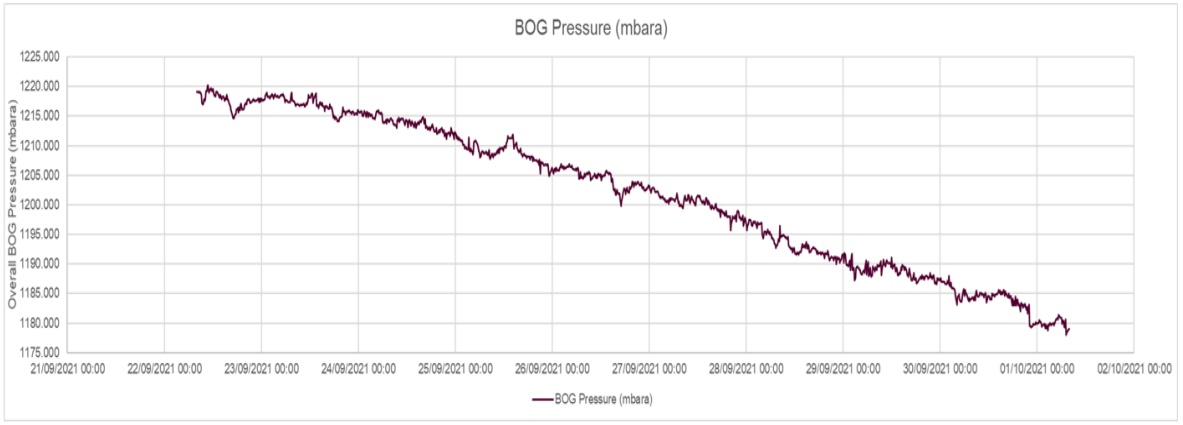
A lower tier than required may be applied, with a minimum of tier 1 (uncertainty of 7.5 %), where the changes are not technically feasible or incurs unreasonable costs, as stated in Article 26 of Commission Implementing Regulation (EU) 2018/2066.

SHLNG requested Emerson to undertake a detailed uncertainty calculation of the orifice plate flow meter (48-FT-93103) in its current design and under current operating conditions, generate a single report detailing the uncertainty of the mass flow rate, define the currently achieved tier by activity data, and provide recommendations of improvement.

2) Trial(s)

The first trial was undertaken on the 06/09/2021, for 24-hour period, and there were no process upsets recorded. A second, more prolonged trial was then undertaken, and this was undertaken between 22/09/2021 to the 01/10/2021. A further one-day trial was undertaken on the 08/10/2021 whilst an LNG Cargo was unloading. All trials were successful and quantified that the site can utilise BOG as a source of Fuel Gas without any process upsets and in fact several advantages to the Terminal's stability at MSO – see benefits.

The data gathered from these trials was sufficient to enable South hook LNG to justify its use longer term whilst at MSO. As illustrated in the graph below, BOG pressure (corrected for Atmospheric pressure) during 9-day trial. Historically this has not been the case, and the Terminal was vulnerable to fluctuations in atmospheric pressure at MSO, which was more difficult to manage.



BOG pressure (corrected for Atmospheric pressure) during 9-day trial

3) GHG permit constraints

SHLNG operates in accordance with Permit Number UK-W-IN-11929. Currently SHLNG has the option to utilise Boil Off Gas (BOG) as Fuel Gas "rarely" *"For all standard operating conditions (including ship unloading) all boil-off gas will be captured either by returning it to the ship, or recondensing it in the LNG,* ***or more rarely by using it as fuel gas in the SCVs".*** This constrains SHLNG from utilising BOG as a source of Fuel Gas under the de-minimis category as per the table below (taken from UK-W-IN-11929 – highlighted yellow). As such, SHLNG can only utilise this option for a period of approx. 25 days a year (for 2021, based on the < 2% de-minimis definition).

Applied tiers

Source Stream Ref.	Emission Source Refs.	Measurement Device Refs.	Overall uncertainty (+/-%)	Activity Data Tier	NCV Tier	Emission Factor Tier	Oxidation Factor Tier	Carbon Content Tier	Conversion Factor Tier	Biomass Fraction Tier	Category
F1	S1,S10,S11,S12,S13,S14,S15,S2,S24,S3,S4,S5,S6,S7,S8,S9	TAG-49-FT-93001	<1.5%	4	3	3	1	N/A	N/A	N/A	Major
F3	S1,S2,S3,S4,S5,S6,S7,S8,S9,S10,S11,S12,S13,S14,S15	TAG-48-FT-93103	N/A	No tier	3	3	1	N/A	N/A	N/A	De-minimis
F2	S16,S17,S18,S19,S20,S22,S23	EST1,EST3	N/A	No tier	2a	2a	1	N/A	N/A	N/A	De-minimis
F1,F3	S21	EST2	N/A	No tier	N/A	1	1	N/A	N/A	N/A	De-minimis
F4	S22	EST4	N/A	No tier	2a	2a	1	N/A	N/A	N/A	De-minimis
F5	S22	EST5	N/A	No tier	1	1	1	N/A	N/A	N/A	De-minimis

4) SHLNG's requirements from the NRW – Justification

Due to the prevailing financial LNG market, SHLNG expect there to be, in the future, prolonged periods of MSO.

Following these recent trials, BOG as fuel gas has proven to maintain SHLNG's BOG pressure significantly lower than on our standard MSO operation when corrected for atmospheric pressure. This maintains the stability, and resilience, of the plant and reduces the probability of flaring by reducing the probability of a plant upset during periods of MSO.

The use of BOG as Fuel Gas improves reliability by reducing the impact of variable atmospheric pressures, which directly affects our BOG pressure and terminal stability. This directly improves process safety and supplier reliability to the national grid.

In addition, in this mode of operation, SHLNG do not require the use of Fuel Gas heaters (electrical consumption 627kWh) which further reduces the Process safety risk from heater incidents and has the secondary advantage in energy savings.

Furthermore, SHLNG are evaluating through the trial, any wider efficiencies through the plant process (e.g., compressor operation philosophy), and potential for NOx reduction due to the composition of BOG.

5) Benefits

- *Assurance of safe, reliable and compliant operations at MSO.*
- *Improved BOG Pressure Management < 250 mb - Greatly reduced risk of flaring*
- *Reduced risk of entire Terminal trip, from higher Fuel Gas Heater availability / resilience.*
- *Improved confidence in operating at MSO by all stake holders.*

6) Further Work

In relation to the teleconference (NRW GHG permit team – Elizabeth Voice and Hannah Toberman) to discuss SHLNG current Permit status. As advised by the NRW, SHLNG are requesting a temporary relaxation for a minimum of 3 months of our current permit which allows SHLNG to utilise BOG as Fuel Gas during periods of MSO, whilst we progress a formal permit variation request.

As requested, SHLNG have requested Emerson Automation Solutions (Emerson) to undertake a detailed uncertainty calculation for the current methodology that SHLNG utilise to measure BOG as Fuel Gas (See Emerson Uncertainty calculation report - attached to this Notification).

In order to calculate the current uncertainty, Emerson requested all the data from SHLNG and calculated our current uncertainty (today) to fall under un tiered classification (de-minimis). With some minor adjustments (which SHLNG can commit to) Emerson have calculated that SHLNG can achieve a Tier 1 classification.

SHLNG request a relaxation of our permit in relation to (F3) BOG as a source of Fuel Gas to permit the Terminal to continue to utilise BOG as source of Fuel gas uninhibited by our Permit, until we officially vary the permit to reflect this.

In the meantime, SHLNG will compile a Permit Variation (and MMP update) explaining the above. It is SHLNG understanding that this can take, once submitted to the NRW, up to 2 months to review and approve. SHLNG estimate that it will take approximately one month to compile the variation, so SHLNG are requesting a relaxation until the Permit is varied and approved.

If there is any further information you require, please do not hesitate to call.

We look forward to hearing from you.

Yours faithfully,

Eamon O'Loughlin

Eamon O'Loughlin

[Health and Safety Officer]

Encs. [Emerson: Consultancy Report, South Hook LNG Terminal,48-FT-93103 Boil-Off Gas Flow Meter Uncertainty Calculation]